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BINARY STAR ORBITS. IV. ORBITS OF 18 SOUTHERN INTERFEROMETRIC PAIRS

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ABSTRACT

First orbits are presented for 3 interferometric pairs and revised solutions for 15 others, based in part on first results from a recently initiated program of speckle interferometric observations of neglected southern binaries. Eight of these systems contain additional components, with multiplicity ranging up to 6.

Key words: binaries: close – stars: individual (42 Cet, 36 Ser, β Sco, V505 Sgr, 74 Aqr)

1. INTRODUCTION AND NEW MEASURES

While binary stars in the northern hemisphere have been observed for many years on a regular basis using various high-resolution techniques (e.g., Horch et al. 2010; Balega et al. 2007; Docobo et al. 2008; Hartkopf & Mason 2009; McAlister et al. 1996; Prieur et al. 2009), their southern counterparts have received more limited attention. A recent program using a new speckle camera (Tokovinin et al. 2010, henceforth Paper I) has been undertaken to rectify this situation. Initial efforts have concentrated on observing pairs judged to require only a small amount of additional data in order to determine either first orbits or corrections to previously published elements seen to be in need of improvement. In this paper, we present the first sets of orbital elements to result from these data.

In addition to the published measures from Paper I and earlier measures tabulated in the Washington Double Star (WDS; Mason et al. 2001) database, a significant number of measures for these pairs come from various previously unpublished sources. These included re-reductions or unpublished CHARA speckle interferometry data (see Hartkopf et al. 2000), unpublished USNO speckle data (see Mason et al. 2009), and observations recently obtained with HRCam (as described in Paper I). These unpublished data are listed in Table 1. In this table, the first column gives the epoch-2000 coordinate, which is the primary identifier from the WDS. Columns 2 and 3 list the discoverer designation and an alternate designation, respectively. Column 4 lists the epoch of the observation expressed as a fractional Besselian year, and Columns 5 and 6 give the measured position angle (θ) and angular separation (ρ). Note that while equinox-2000.0 coordinates are provided, position angles have not been corrected for precession and are thus based upon the equinox for the epoch of observation. Column 7 provides the characteristics of the filter used in the observation (central wavelength/FWHM, in nanometers) when known. The final column gives the aperture of the telescope in meters where the observation was obtained. This also uniquely defines the telescope: either the 4.2 m SOAR, the 4.0 m Blanco, the 3.8 m Mayall, or the 2.5 m Mt. Wilson Hooker telescope. Data obtained prior to 2001 were obtained with the CHARA speckle camera (Hartkopf et al. 2001), those after 2008 with HRCam (Paper I), and all other data with the USNO speckle camera (Mason et al. 2009).

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2. NEW ORBITAL SOLUTIONS

All orbits were either corrected or their first orbits attempted using the "grid search" routine described in Hartkopf et al. (1989); weights are applied based on the methods described by Hartkopf et al. (2001). Elements for these systems are given in Table 2, where Columns 1 and 2 give the WDS and discoverer designations (followed by an alternate designation) and Columns 3–9 list the seven Campbell elements: P (period, in years), a (semimajor axis, in arcseconds), i (inclination, in degrees), Ω (longitude of node, equinox 2000.0, in degrees), T_0 (epoch of periastron passage, in fractional Besselian year), e (eccentricity), and ω (longitude of periastron, in degrees). Formal errors are listed below each element. Columns 10 and 11 provide the orbit grade (see Hartkopf et al. 2001) and weighted rms residuals in θ and ρ for all measures used in the solution. Columns 12 and 13 give the reference for a previous orbit determination, if one exists, and weighted rms residuals in θ and ρ for that solution. Columns 11 and 13 are included in part to allow a more objective numerical comparison of the new and old solutions, in addition to the visual comparison provided by the figures.

A quick inspection of Table 2 will reveal that half of these new pairs were first resolved by W. S. Finsen with his eyepiece interferometer. While these lower accuracy data are of less value in refining orbits, many of these pairs would not have been observed in the first place were it not for the monumental observing effort made by this great South African visual interferometrist.

Figures 1–4 illustrate the new orbital solutions plotted together with all published data in the WDS database as well as the unpublished data in Table 1. In each of these figures, micrometric observations are indicated by plus signs, modern interferometric measures by filled circles, and older eyepiece interferometry measures by open circles; *Hipparcos* measures are indicated by the letter "H." "$O - C$" lines connect each measure to its predicted position along the new orbit (shown as a thick solid line). Dashed "$O - C$" lines indicate measures given zero weight in the final solution. A dot-dashed line indicates the line of nodes, and a curved arrow in the lower right corner of each figure indicates the direction of orbital motion. Finally, the previous published orbit (when one exists) is shown as a dashed ellipse. The source of that orbit is listed in the 12th column of Table 2.

Table 3 gives ephemerides for each new orbit over the years 2010 through 2015 in annual increments. Columns 1 and 2 are the same identifiers as in the previous table, while Columns

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14. ABSTRACT
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Table 1
New Speckle Interferometric Measures

WDS or α,δ (2000)	Discoverer Designation	Other Designation	Date (BY)	θ (°)	ρ ($''$)	$\lambda/\Delta\lambda$ (nm)	Tel (m)
01198−0031	FIN 337 BC	42 Cet	1994.7085	202.0	0.081	549/22	3.8
			2009.6710	32.2	0.133	774/	4.2
14462−2111	FIN 309	HD 129980	2006.1890	188.6	0.158	550/24	4.0
15513−0305	CHR 51	36 Ser	1996.3298	101.2	0.114	549/22	2.5
			1996.5397	101.8	0.122	549/22	2.5
			1997.1322	99.9	0.139	549/22	2.5
			2007.5876	248.4	0.295	550/24	3.8
			2008.4556	248.3	0.303	550/24	3.8
20311−1503	FIN 336	HD 195330	1997.4575	105.6	0.111	549/22	2.5
			2007.5880	116.9	0.146	550/24	3.8
			2009.6705	304.7	0.152	774/	4.2
			2009.6705	304.8	0.153	596/121	4.2
21274−0701	HDS 3053	HD 204236	2007.5880	144.0	0.211	550/24	3.8
			2009.6707	159.0	0.195	774/	4.2
23529−0309	FIN 359	24 Psc	2009.6708	355.7	0.055	774/	4.2

(3+4), (5+6), . . . , and (13+14) give predicted values of θ and ρ, respectively, for the years 2010.0, 2011.0, etc., through 2015.0. All pairs are relatively fast moving, with mean motions of more than 6° yr^{-1}.

3. NOTES TO INDIVIDUAL ORBIT SYSTEMS

01198−0031 = FIN 337BC = 42 Cet. The orbital period was determined using all data, but all other elements were determined by then fixing that period and using only speckle interferometry data. The 1982.850 measure of Tokovinin (1983) was given zero weight in the orbit solution. One historical unpublished CHARA measure is listed in Table 1 along with a very recent measure. Using the *Hipparcos* (Perryman et al. 1997) parallax and error from the more recent reduction of van Leeuwen (2007), the mass sum calculated from these elements, 1.79 ± 0.60 $M_\odot$, is consistent with the A7V (Bidelman 1958) of the secondary and a companion of unknown but likely similar type. The physical component A (G8III) is at 1$''$.6 from BC.

05525−0217 = HDS 787 = HD 39438. This is the first orbit solution for this pair. The mass sum predicted from these elements is 1.29 ± 0.44 $M_\odot$ which is a little low for the F8+G8 pairing of Balega et al. (2002). The orbit can perhaps be substantially improved over the next several years, as it is predicted to pass quite quickly through periastron in 2012.53.

08125−4616 = CHR 143Aa,Ab = HD 68895. Another first orbit, the very significant northern measure seen in Figure 1(c), is actually two measures. This pair should go through periastron soon (2013), but due to the higher eccentricity its motion is much more rapid as seen in Table 3. The mass sum derived from these elements is very uncertain: 27 ± 40 $M_\odot$. Adopting the mass sum 11.5 $M_\odot$ appropriate for a B5V spectral type (Hiltner et al. 1969) and a slightly lower mass companion, we can derive a dynamical parallax 4.1 mas. The physical tertiary companion B is currently at 0$''$.61 from Aa,Ab.

09243−3926 = FIN 348 = HD 81411. Not a first orbit, but the previous orbit (Mason & Hartkopf 2001) is not plotted due to scaling concerns. The mass sum predicted from these new elements is 4.3 ± 1.1 $M_\odot$, which is reasonably consistent with expectation for an A6/7III (Houk 1982) and a similar companion. New measures (Mason et al. 2009; Paper I) found to the west in Figure 1(d) have demonstrated that the previous 470 yr period orbit was incorrect. The star is suspected to have variable radial velocity (Nordstrom & Andersen 1985).

13145−2417 = FIN 297 AB = HD 114993: The 1977.0876 measure of McAlister & DeGioia (1979) was given zero weight in the orbit solution. The mass sum predicted from these elements is 0.93 ± 0.62 $M_\odot$, a bit low for an Am star and a fainter companion (Abt 1981). Compared to the previous orbits of Baize (1988) and Manté (2004b), the new orbit has a smaller a'' and P and fits the recent data much better. The tertiary component C at 12$''$.4 is physical.

13574−6229 = FIN 370 = HD 121454. The mass sum calculated from new elements is 3.06 ± 0.68 $M_\odot$. Cutispoto et al. (2002) give the spectral type as G4IV/III+G2IV/III.

14462−2111 = FIN 309 = HD 129980. Söderhjelm (1999) published elements with a period about twice those published here. The closer measures subsequently obtained resolved the quadrant ambiguity of other measures, yielding this shorter-period solution. This solution also includes one unpublished USNO speckle measure obtained in 2006 with the CTIO 4 m telescope. The mass sum is 2.50 ± 0.29 $M_\odot$ and the spectral type from Abt (1981) is G1V.

14567−6247 = FIN 372 = θ Cir. The mass sum is 40 ± 18 $M_\odot$. While the number of interferometric measures of this B3Ve (Slettebak 1982) star and its companion of unknown spectral type has doubled in the past 10 years, many more measures are needed.

15513−0305 = CHR 51 = 36 Ser. Two recent unpublished USNO speckle measures made with the KPNO 4 m and three CHARA speckle measures made with the Mt. Wilson 100$''$ supplement the published data here. These are listed in Table 1. While a linear fit is also possible for these data (see Figure 4), definitive quadrant analysis of historical data (Bagnuolo et al. 1992) and recent measures of magnitude difference (Paper I) make it clear that the orbit solution (Figure 2(c)) is more likely to be correct. Three unpublished CHARA speckle measures were initially placed in the wrong quadrant leading to an erroneous solution in Hartkopf & Mason (2009). The final columns of Table 3 here provide the difference between the new orbit and that of Docobo & Tamazian (2009). The mass sum predicted from these new elements is 3.09 ± 0.47 $M_\odot$ for this A7+G0 pair (Faraggiana et al. 2004). *16054−1948 = MCA 42CE = β Sco.* The relationships of the various components in this young high-order multiple system are illustrated in the mobile diagram in Figure 5. The 1977.0876 measure of McAlister & DeGioia (1979) was given zero weight in the orbit solution. The orbit

Table 2
New Orbital Elements

WDS (Figure No.)	Discoverer Desig. Other Desig.	P (yr)	a ($''$)	i ($^\circ$)	Ω ($^\circ$)	T_0 (yr)	e	ω ($^\circ$)	Grade	σ_θ (deg) σ_ρ (mas)	Previous Orbit	σ_θ (deg) σ_ρ (mas)
01198−0031	FIN 337 BC	27.028	0.10855	16.8	194.0	1995.04	0.215	13.0	2	2.5	Mason & Hartkopf (1999)	5.8
(1a)	42 Cet	±0.090	±0.00071	±2.8	±17.0	±0.13	±0.011	±18.0		6.5		7.3
05525−0217	HDS 787	12.10	0.1157	54.0	149.8	2000.43	0.179	289.8	3	4.4	First orbit	...
(1b)	HD 27758	±0.36	±0.0040	±4.0	±3.5	±0.26	±0.024	±8.9		8.7		...
08125−4616	CHR 143 Aa,Ab	25.9	0.082	76.9	167.3	1987.68	0.61	259.0	3	1.1	First orbit	...
(1c)	HD 68895	±5.4	±0.017	±2.4	±6.9	±0.28	±0.18	±11.0		2.9		...
09243−3926	FIN 348	40.0	0.1275	149.7	222.1	1984.38	0.548	107.0	3	0.5	Mason & Hartkopf (2001)	15.7
(1d)	HD 81411	±1.0	±0.0016	±1.4	±7.5	±0.23	±0.012	±4.9		1.3		32.3
13145−2417	FIN 297 AB	61.3	0.1520	20.0	180.0	1969.6	0.687	345.0	3	0.9	Manté (2004a)	2.2
(1e)	HD 114993	±1.1	±0.0052	±13.0	±33.0	±1.5	±0.023	±38.0		4.6		16.8
13574−6229	FIN 370	18.57	0.1469	152.2	284.0	2006.54	0.201	32.0	2	2.6	Manté (2004b)	4.9
(1f)	HD 121454	±0.15	±0.0034	±5.9	±13.0	±0.32	±0.023	±18.0		9.2		11.7
14462−2111	FIN 309	12.929	0.1814	25.9	281.9	1995.249	0.6428	39.5	2	0.7	Söderhjelm (1999)	3.1
(2a)	HD 129980	±0.021	±0.0021	±2.6	±4.1	±0.055	±0.0051	±4.7		4.9		9.4
14567−6247	FIN 372	39.62	0.08564	153.3	228.0	1993.81	0.3041	68.6	3	1.3	Cvetkovíc (2009)	2.1
(2b)	θ Cir	±0.78	±0.00056	±2.0	±5.2	±0.12	±0.0081	±6.5		2.4		8.7
15513−0305	CHR 51	50.6	0.4003	98.08	74.00	2002.78	0.8323	72.84	3	0.6	Docobo & Tamazian (2009)	3.4
(2c)	36 Ser	±1.5	±0.0060	±0.31	±0.31	±0.17	±0.0047	±0.91		2.9		24.9
											Hartkopf & Mason (2009)	1.7
												36.4
16054−1948	MCA 42 CE	39.0	0.1328	41.1	184.0	2034.2	0.029	350.0	3	5.1	Seymour et al. (2002)	12.7
(2d)	β Sco	±2.9	±0.0060	±9.0	±14.0	±9.9	±0.057	±111.0		19.7		19.6
17156−3836	FIN 355	14.215	0.2527	115.2	190.41	1985.98	0.4912	135.2	2	0.2	Söderhjelm (1999)	2.7
(2e)	HD 155826	±0.050	±0.0043	±1.1	±0.62	±0.17	±0.0048	±2.5		1.0		61.1
18465−0058	MCA 53 Aa,Ab	33.65	0.219	97.9	174.3	1989.71	0.333	251.7	3	0.4	First orbit	...
(2f)	5 Aql	±0.78	±0.016	±1.4	±1.9	±0.76	±0.054	±5.9		0.6		...
19407−0037	CHR 88 Aa,Ab	20.31	0.0850	158.3	202.0	1996.06	0.047	346.0	4	3.6	Hartkopf et al. (2000)	9.2
(3a)	45 Aql	±0.17	±0.0020	±7.9	±15.0	±0.92	±0.022	±25.0		1.7		2.1
19531−1436	CHR 90	32.2	0.181	136.0	26.0	2000.61	0.712	20.0	4	0.7	Cvetkovíc (2009)	1.1
(3b)	V505 Sgr	±1.1	±0.011	±14.0	±13.0	±0.85	±0.069	±18.0		4.9		7.5
20311−1503	FIN 336	55.0	0.1581	66.2	150.8	1967.6	0.672	102.4	3	3.8	Olevíc & Cvetkovíc (2003)	13.6
(3c)	HD 195330	±3.2	±0.0063	±2.0	±4.5	±1.9	±0.026	±1.9		9.4		19.4
21274−0701	HDS 3053	20.3	0.171	54.5	154.0	1994.7	0.37	140.0	3	0.5	Balega et al. (2006)	2.2
(3d)	HD 204236	±4.9	±0.018	±3.9	±12.0	±2.6	±0.25	±14.0		4.1		21.0
22535−1137	MCA 73	18.71	0.0793	66.9	110.3	1991.52	0.061	277.0	2	4.7	Mason (1997)	5.8
(3e)	74 Aqr	±0.17	±0.0010	±1.6	±1.1	±0.53	±0.016	±10.0		5.2		5.0
23529−0309	FIN 359	22.81	0.0832	133.7	209.5	1988.72	0.422	298.3	2	2.1	Docobo & Ling (2008)	2.5
(3f)	24 Psc	±0.15	±0.0014	±1.8	±2.7	±0.14	±0.013	±2.4		6.1		8.0

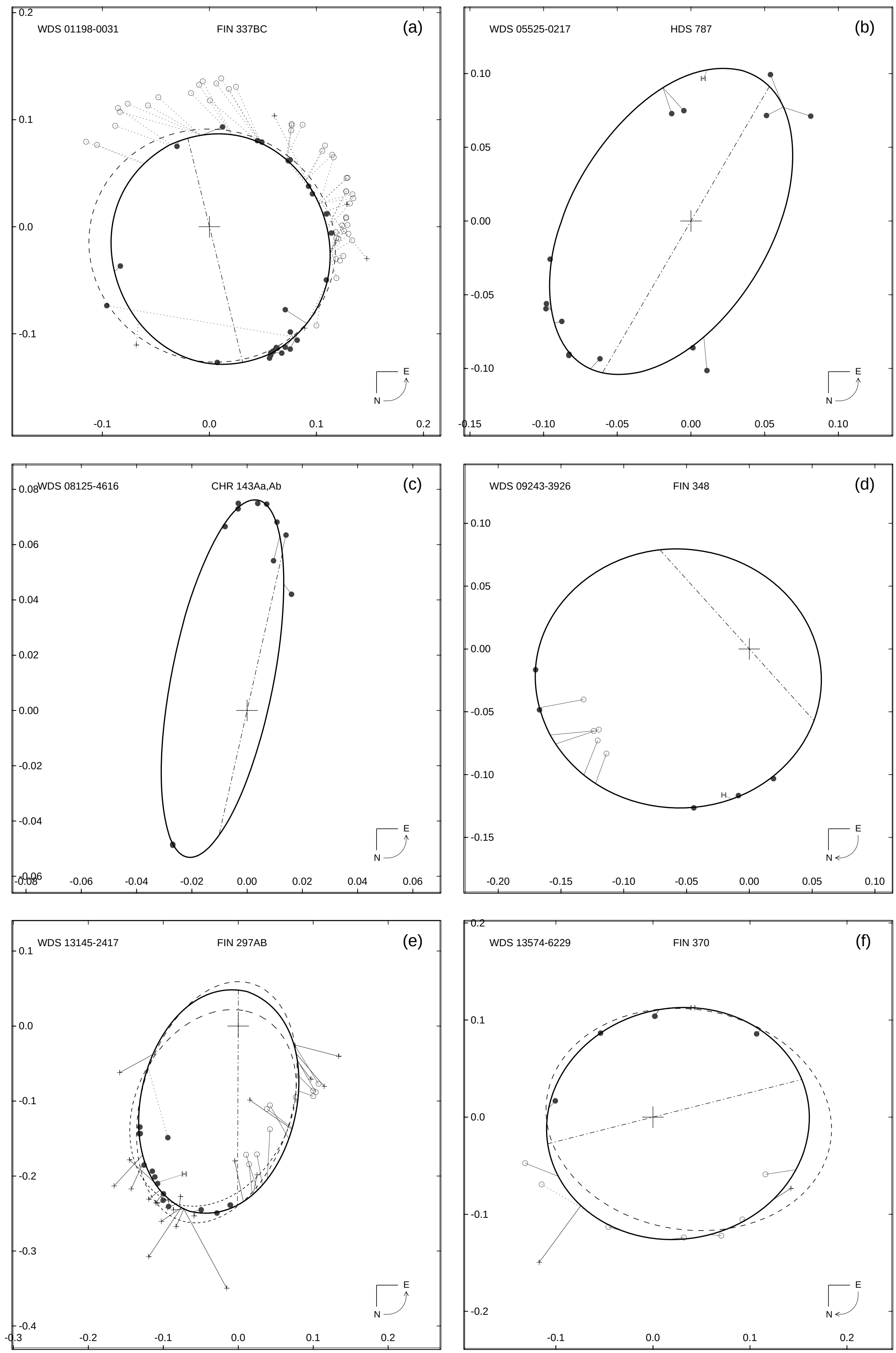

Figure 1. New orbits for the systems listed in Table 2, together with the most recent published elements for these systems and all data in the WDS database or Table 1. See the text for a description of symbols used in this and the following figures.

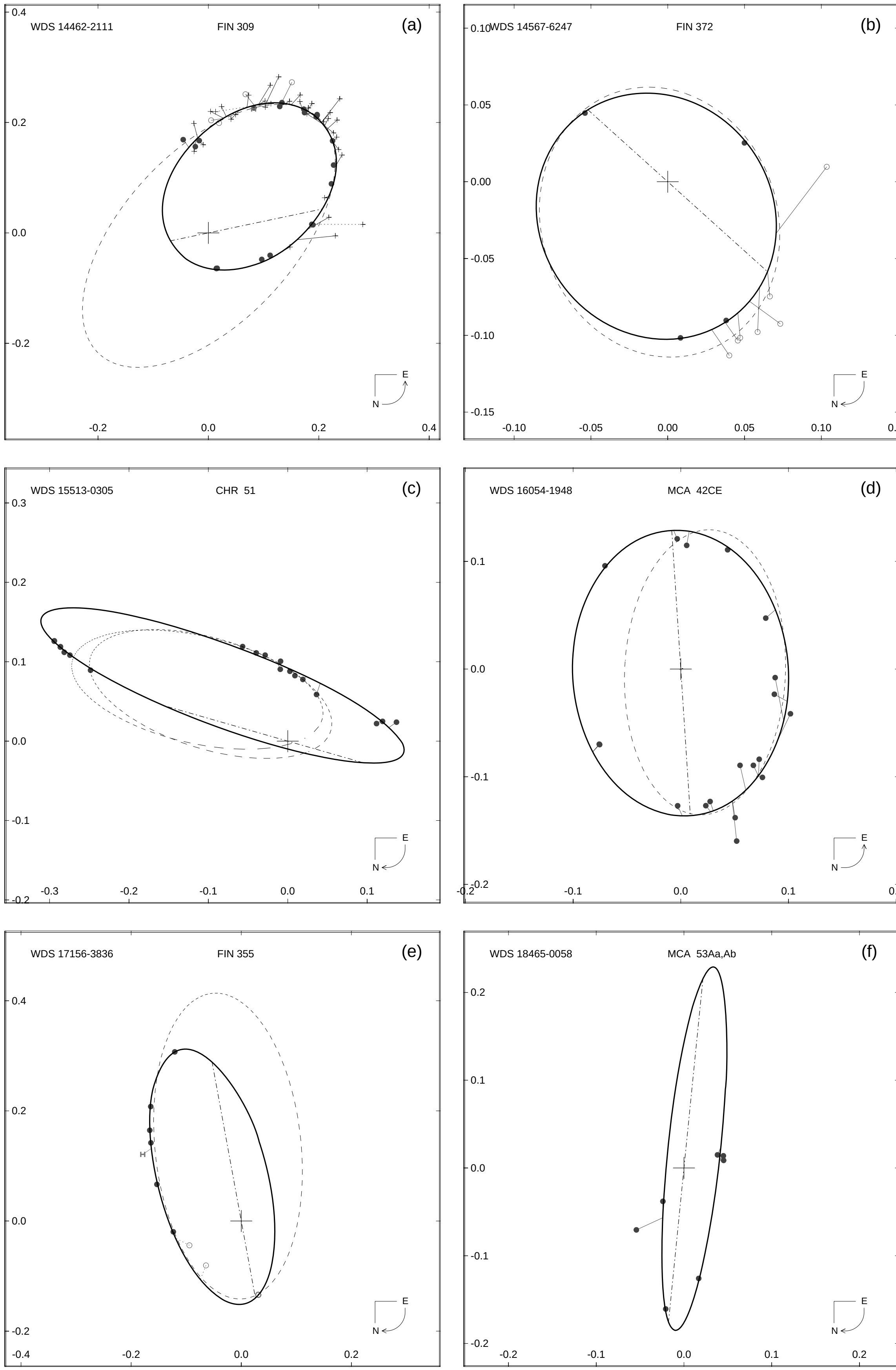

Figure 2. Same as Figure 1.

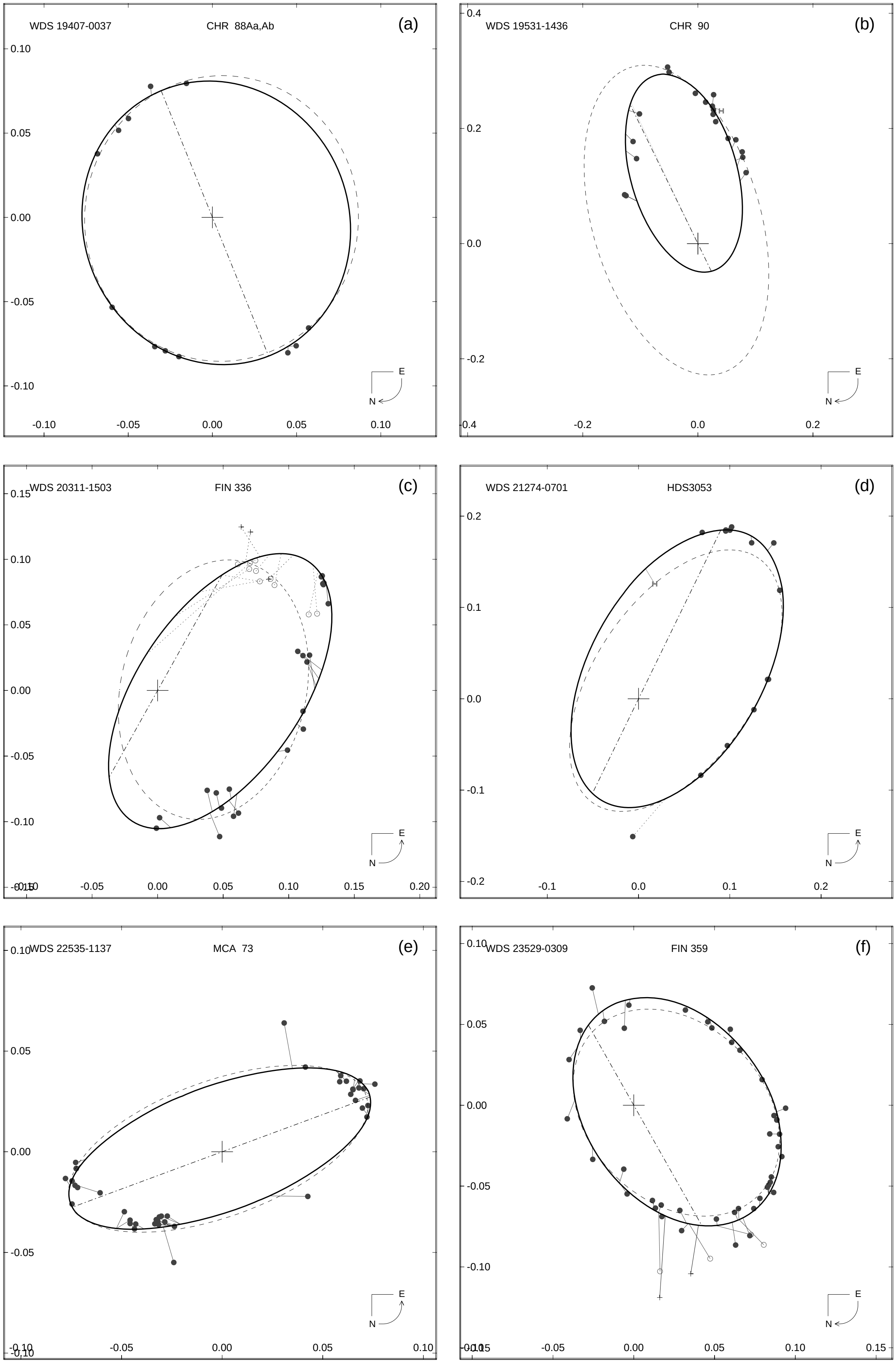

Figure 3. Same as Figure 1.

Table 3
Orbital Ephemerides

WDS Designation	Discoverer Designation	2010.0 θ° ρ''	2011.0 θ° ρ''	2012.0 θ° ρ''	2013.0 θ° ρ''	2014.0 θ° ρ''	2015.0 θ° ρ''
01198−0031	FIN 337 BC	38.7 0.130	47.5 0.128	56.7 0.124	66.5 0.120	77.1 0.116	88.6 0.110
05525−0217	HDS 787	338.1 0.112	2.1 0.083	54.5 0.057	114.8 0.075	143.9 0.102	164.3 0.107
08125−4616	CHR 143 Aa,Ab	334.8 0.057	340.0 0.056	345.9 0.049	357.0 0.029	128.1 0.012	161.7 0.042
09243−3926	FIN 348	272.7 0.169	268.9 0.167	265.1 0.164	261.0 0.160	256.7 0.155	252.2 0.149
13145−2417	FIN 297 AB	0.1 0.238	1.7 0.234	3.5 0.229	5.3 0.224	7.2 0.218	9.2 0.212
13574−6229	FIN 370	159.4 0.120	140.0 0.134	124.1 0.146	110.4 0.155	97.8 0.160	85.8 0.161
14462−2111	FIN 309	90.6 0.176	106.3 0.226	116.9 0.259	125.6 0.279	133.5 0.287	141.2 0.284
14567−6247	FIN 372	1.3 0.103	355.9 0.103	350.5 0.102	345.1 0.102	339.6 0.101	334.0 0.100
15513−0305	CHR 51	246.4 0.328	245.6 0.337	244.8 0.343	244.1 0.346	243.3 0.347	242.6 0.346
16054−1948	MCA 42 CE	320.2 0.116	328.8 0.122	336.8 0.127	344.2 0.131	351.2 0.134	357.9 0.136
17156−3836	FIN 355	197.4 0.326	191.3 0.300	183.2 0.243	166.8 0.146	75.0 0.063	9.7 0.143
18465−0058	MCA 53 Aa,Ab	71.3 0.040	38.7 0.054	22.4 0.076	13.7 0.101	8.4 0.124	4.8 0.146
19407−0037	CHR 88 Aa,Ab	335.9 0.083	318.2 0.081	299.3 0.078	279.7 0.078	260.0 0.078	240.6 0.079
19531−1436	CHR 90	205.6 0.270	203.2 0.281	200.9 0.289	198.8 0.295	196.7 0.299	194.7 0.301
20311−1503	FIN 336	127.3 0.153	129.4 0.152	131.5 0.151	133.7 0.148	136.0 0.144	138.5 0.139
21274−0701	HDS 3053	161.3 0.187	170.6 0.160	184.8 0.123	212.0 0.084	265.1 0.069	310.1 0.094
22535−1137	MCA 73	24.3 0.029	68.0 0.040	88.8 0.057	100.3 0.071	108.7 0.078	116.4 0.077
23529−0309	FIN 359	340.0 0.044	291.0 0.034	241.2 0.043	212.8 0.056	193.5 0.063	177.3 0.067

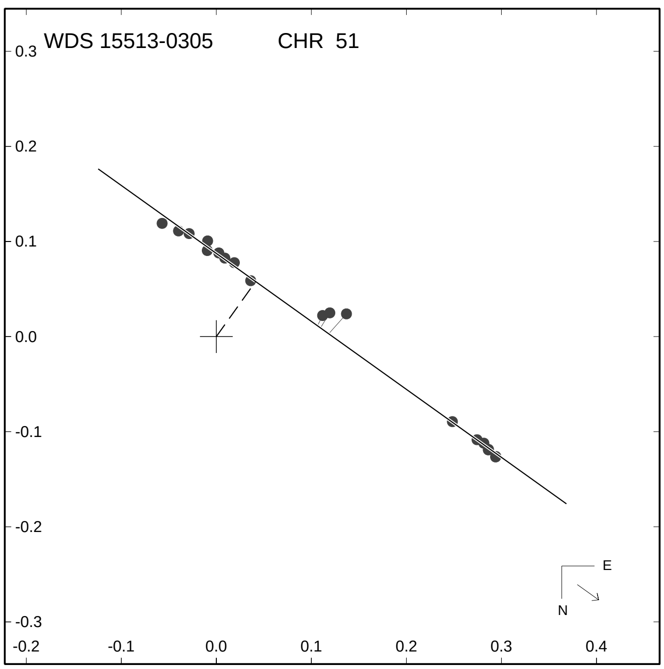

Figure 4. Linear fit to all speckle measures of 36 Ser (= 15513−0305 = CHR 51), with quadrants of the recent data flipped by 180° as needed. The arrow at lower right indicates the direction of relative motion of the secondary; the dashed perpendicular line from the linear fit to the origin indicates the closest relative separation (71 mas, in 1991.87). This linear solution is less likely than the elliptical orbit depicted in Figure 2(c).

of Holmgren et al. (1997), included in the mobile diagram, is of a much closer pair Aa,Ab, as is the orbit of Catanzaro (2010) for Ea,Eb. While the C component is a B2V (Johnson & Morgan 1953), recent analysis of the system (Catanzaro 2010) classified Ea as a mercury–manganese star. The Aa,Ab orbit was obtained by combining spectroscopic and occultation data and provides the most accurate distance to this system through orbital parallax, $\pi = 7.1$ mas. This is in agreement with the *Hipparcos* parallax. However, adopting component's masses of C,Ea,Eb estimated from the spectral types (mass sum 18.6 $M_\odot$), we obtain a discordant dynamical parallax of 4.4 mas from the new orbit. The visual orbit of AB with 610 yr period (Seymour et al. 2002) is suspect because it gives an even more discordant dynamical parallax. The available data only cover $\frac{1}{3}$ of the calculated period. This interesting multiple system clearly deserves further study.

The nomenclature of the components deserves some mention for this complex multiple system. As of the 1970s, four components of the multiple system were known. In van Flandern & Espenschied (1975) they include the visual A, B, and C components noted above, as well as the 6.8 day spectroscopic companion, which they refer to as "D." They then described the detection by lunar occultation of three more components: E and F (both components of C) and G (a close component of B). While the G component was only postulated based on mass arguments, component F was implied from the detailed structure of the 1971 occultation by Io (Bartholdi & Owen 1972). The component designation was changed slightly in 1976 when Elliott et al. (1975) redesignated the spectroscopic AD pair as A_1–A_2, a designation that was reinforced in Evans et al. (1977). Following the protocols recommended by the IAU (Hartkopf & Mason 2004), the close spectroscopic pair is now known as Aa,Ab. It is quite likely that the EF pair is the same as the 10.68 day pair of Catanzaro (2010). The shifting components if nothing else give further evidence for the importance of clear nomenclature policy for stellar companions. In any event, the first speckle resolution of the close CE pair followed so closely upon its first detection by occultation that the CE designation was well established and was not designated Ca,Cb as might have been expected by modern schemes. The older designations of Ab [née A_2 (née D)] were historic and not retained. So, the complex multiple system is one without a D component.

17156−3836 = FIN 355 = HD 155826. Recent measures have shown this pair to be closing in rather sooner than predicted by the orbit of Söderhjelm (1999). The mass sum of this high proper motion pair is $2.29 \pm 0.26\,M_\odot$. The primary was classified as F9.5V in Gray et al. (2006).

18465−0058 = MCA 53Aa,Ab = 5 Aql. A first orbit determination for this pair is now possible due to the most recent measures, but this must be viewed as a very preliminary solution. The mass sum predicted from these elements is $13.0 \pm 8.4\,M_\odot$

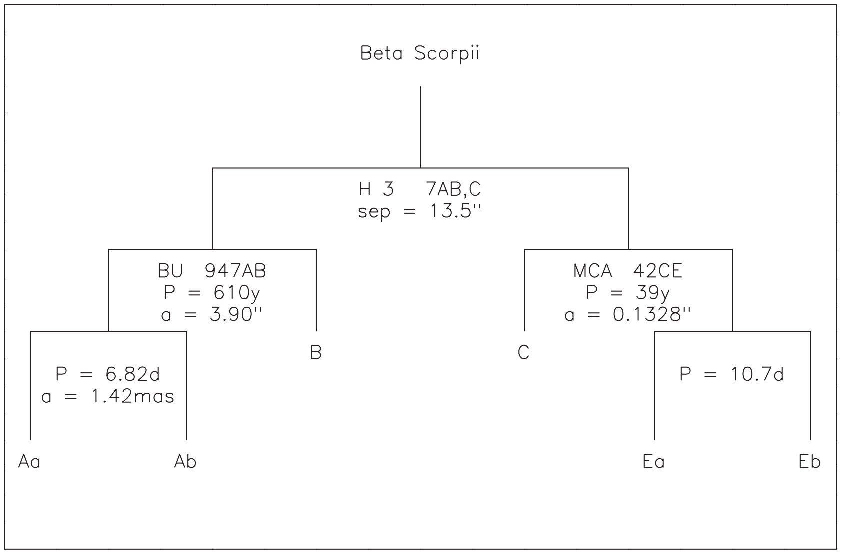

Figure 5. Mobile diagram of the β Sco (= 16054−1948) multiple system.

Table 4
System Parameters

WDS Designation	Discoverer Designation	Parallax (mas)	Spectral Type	Mass Sum ($M_\odot$)
01198−0031	FIN 337 BC	9.93 ± 1.03	A7V+?	1.79 ± 0.56
05525−0217	HDS 787	20.15 ± 1.19	F8+G8	1.29 ± 0.28
08125−4616	CHR 143 Aa,Ab	3.12 ± 0.44	B5V+?	27.0 ± 23.0
09243−3926	FIN 348	6.71 ± 0.37	A6/A7III+?	4.29 ± 0.76
13145−2417	FIN 297 AB	9.99 ± 1.68	Am+?	0.93 ± 0.48
13574−6229	FIN 370	14.43 ± 0.65	G4IV/III+G2IV/III	3.06 ± 0.47
14462−2111	FIN 309	24.24 ± 0.63	G1V	2.50 ± 0.21
14567−6247	FIN 372	2.16 ± 0.29	B3Ve+?	40.0 ± 16.0
15513−0305	CHR 51	20.10 ± 0.33	A7+G0	3.09 ± 0.28
16054−1948	MCA 42 CE	8.19 ± 1.17	B2V+HgMn+?	2.9 ± 1.3
17156−3836	FIN 355	32.69 ± 0.59	F9.5V+?	2.29 ± 0.17
18465−0058	MCA 53 Aa,Ab	8.94 ± 1.14	Am+Am+?	13.0 ± 5.8
19407−0037	CHR 88 Aa,Ab	9.26 ± 0.70	A3IV+?	1.87 ± 0.45
19531−1436	CHR 90	8.40 ± 0.57	A2V+F/GIV+F7V	9.6 ± 2.7
20311−1503	FIN 336	8.56 ± 0.48	K1/2III+F	2.08 ± 0.49
21274−0701	HDS 3053	17.48 ± 1.02	F8+G8	2.3 ± 1.4
22535−1137	MCA 73	3.95 ± 0.40	B8IV/V+?+?	23.1 ± 7.1
23529−0309	FIN 359	7.28 ± 0.46	G9III+A0V	2.87 ± 0.56

for the pair of Am stars (Abt & Cardona 1984), although one of these components is also a double-lined spectroscopic binary with a 4.77 day period component (Abt & Levy 1985). The tertiary component B at 12.″8 is physical.

19407−0037 = CHR 88 Aa,Ab = 45 Aql. Measures in the northwest quadrant, not to become available for at least a decade, should significantly improve this fit. The current mass sum estimate of 1.87 ± 0.59 $M_\odot$ is much lower than expected for a pair with A3IV primary (Cowley et al. 1969). However, *Hipparcos* detected an acceleration and its parallax measurement could be wrong. The faint red ($V = 14.06$, $B - V = 1.30$) companion B at 42.″7 has common proper motion; it is physical.

19531−1436 = CHR 90 = V505 Sgr. Reassessing the position angle of the most recent observations yields a solution of approximately half the period and a much higher eccentricity than that of Cvetkovíc (2009). The mass sum predicted from these elements is 9.6 ± 4.4 $M_\odot$. The total mass of the brighter component, itself a 1.18 day spectroscopic and eclipsing binary composed of an A2V and a F/GIV, is 3.34 ± 0.14 $M_\odot$. The more distant speckle companion is probably of F7V spectral type (Tomkin 1992). Chambliss et al. (1993) estimate it to be 1.2 $M_\odot$. Our visual orbit leads then to the dynamical parallax of 10.8 mas, in agreement with the *Hipparcos* parallax of 8.6 ± 1.4 mas. The tertiary companion with an orbital period of 38.4 yr and high eccentricity was independently found by Mayer (1997) from the minima timings of the eclipsing pair. This early orbit roughly agrees with the present orbital solution. Recent work by Brož et al. (2010) postulated on a possible fourth companion and discussed the complex dynamics of the system.

20311−1503 = FIN 336 = HD 195330. The orbital period was determined from all data, but all other elements were determined by fixing the period and using only speckle interferometry data. Two recent unpublished HRCam observations using the SOAR telescope, plus one made with the USNO speckle camera on the KPNO 4 m and one with the CHARA speckle camera on the Mt. Wilson 100″, all supplement the published data here. The mass sum is 2.08 ± 0.84 $M_\odot$ for the K1/2III+F

pair (Houk & Smith-Moore 1988). The quadrant was flipped for the 2009 HRCam observations.

21274−0701 = HDS3053 = HD 204236. The 1997.7201 measure of Mason et al. (1999) made with the McDonald Observatory 82″ is given zero weight in this orbit solution, which generates a predicted mass sum of $2.3 \pm 2.2\, M_{\odot}$ for the F8+G8 (Balega et al. 2002) pair. One recent unpublished HRCam observation and one USNO speckle measure are included in Table 1.

22535−1137 = MCA 73 = 74 Aqr. A short-period, high-eccentricity solution, which required flipping some measures by 180°, was also attempted. However, the low-*e* solution consistent with the earlier orbit of Mason (1997) fits better and yields smaller errors. Periastron for this pair is predicted for Spring 2010. The mass sum is $23.1 \pm 8.3\, M_{\odot}$. The visual primary is also a 3.43 day double-lined spectroscopic pair (Catanzaro & Leto 2004). The spectral classification of B8IV/V (Houk & Smith-Moore 1988) is for the primary of this triple system.

23529−0309 = FIN 359 = 24 Psc. A recent HRCam observation is included in Table 1. The mass sum predicted from these elements is $2.87 \pm 0.73\, M_{\odot}$. The primary is a G9III while the secondary spectral type of A0V determined by Mason (1997) was based on the lunar occultation magnitude differences of Evans & Edwards (1981). Periastron for this pair is predicted for mid-2011, and multiple observations as it goes through this important phase can help refine its orbit further.

Table 4 provides a summary of the parallax, spectral type, and mass sum for all these systems. Parallaxes are from the van Leeuwen (2007) *Hipparcos* reductions, while the spectral type information is a summary of that from the above-mentioned references. Due to the proximity of many of these pairs, the spectral type of the companion is often unknown; these are indicated by a "?" in Table 4. However, due to the limited Δm capability of speckle interferometry and the prevalence of "stellar twins" (Raghavan et al. 2010), the unknown companion is often quite similar to the primary. The mass sum is that based on the Table 2 solution and the parallax.

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